Space Weather Technical Forecast

Issued on Saturday, 09 April 2022 at 01:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor Geomagnetic Storms, mainly day 2 (10th)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours. There are four sunspot regions on the Earth-facing disc, all of which are relatively simple, with the largest AR2978 Hhx/alpha the source of a C1- flare, the most energetic that was observed in the last 24 hours. All other regions are small, stable and showing either little growth or signs of decay. No Earth-directed CMEs were observed, although there are a number of filaments on the Earth-facing disc, including a large northern hemisphere central disc filament that will need monitoring for any potential lift.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was indicative of a glancing interaction with a passing CME. This arrived at 08/0338 UTC with a small speed increase, to 380 km/s, then declined to vary 340-370 km/s throughout. The density of the wind was briefly above average with the arrival, peaking 16 ppcc, before declining to average values. The interplanetary magnetic field (IMF) strength, Bt, increased to Moderate at 08/0340 UTC, peaking at 11 nT at 08/0559 UTC with a slow decline observed until 08/2155 UTC when an increase to Moderate values was again observed. The north-south component ranged between -8 and +6 nT, but was predominately positive until 08/2100 UTC when it turned negative. The Phi angle was stable, just about negative (towards the Sun) until 08/2100 UTC when a rotation occurred, followed by a more definitively negative directed angle. Geomagnetic activity was Quiet to Active.

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES-16 at GEO was at background levels. The high energy (greater than 2MeV) electron flux was at normal background. The corresponding 24-hour fluence was below the Active threshold (1e8 integrated pfu) and declining. 2.8e6 integrated pfu was observed at 09/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Very Low, with only small and simple sunspots on the disc. There is a very slight chance of M-flares day 1 (9th) before declining as AR2978 rotates away, over the limb.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on the 7th due to a filament eruption is expected to miss Earth, passing just behind and to the south, but with a chance of a glancing interaction late on day 2 (10th). Otherwise background solar winds are likely to become enhanced day 2 (10th), with a slight chance day 1 (9th) due to the arrival of coronal hole fast wind from CH72/73. Geomagnetic activity is forecast to be Quiet, isolated Unsettled at first on day 1 (9th), increasing to Active with a chance of G1/Minor Storms from the fast wind arrival, most likely on day 2 (10th). Geomagnetic activity then easing to Quiet to Unsettled later day 3 and day 4 (11th and 12th).

Energetic Particles / Solar Radiation: The high energy (greater than 10MeV) proton flux is expected to persist at background levels. The high energy (greater than 2 MeV) electron flux is

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forecast to remain at background to Moderate levels until late day 2 (10th) onward, then rising, with a chance of reaching High by the end of the period. The associated 24 hour fluence is forecast to remain below the Active threshold but with a slight chance of rising above day 3 and 4 (11th and 12th).

Figure 1: Observed Solar winds on 8th at L1 showing a clear CME profile

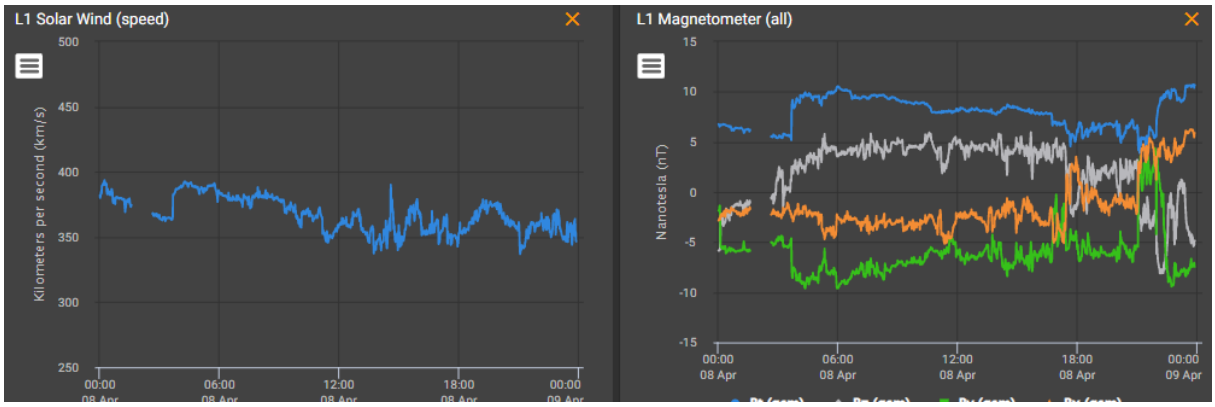

Figure 2: H-alpha imagery (Cerro Tololo) showing large number of filaments on Earth-facing disc

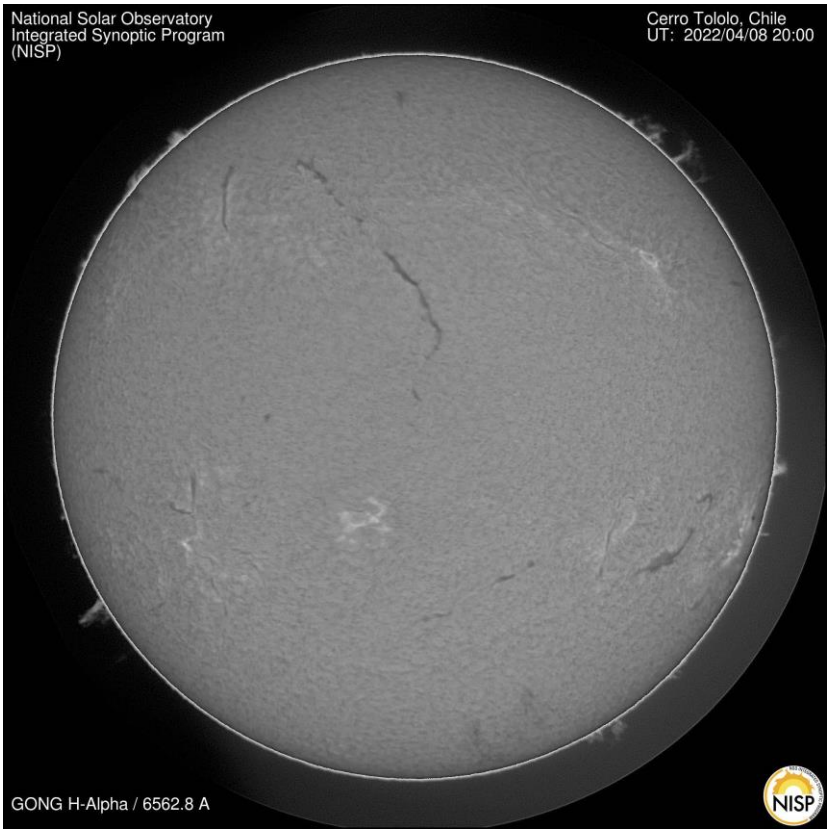

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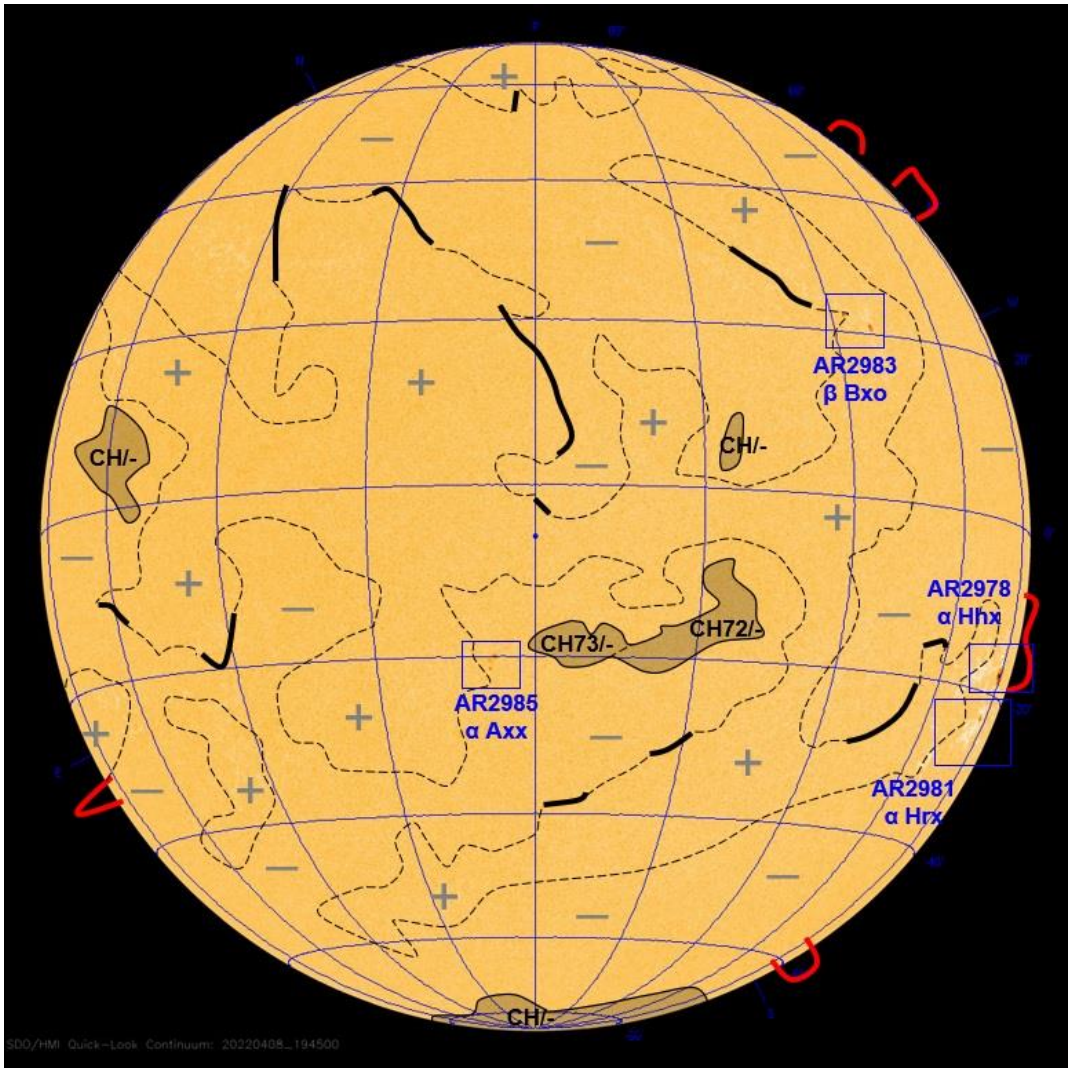
Figure 3. Solar Analysis Valid 08/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds at Earth have been indicative of a CME glance early on the 8th, likely the early arrival of the CME that was previously forecast to have a chance of glancing later in the day, or perhaps on the 9th. A further CME, from a filament eruption on the 7th, is anticipated to pass close to Earth late day 2 (10th). This will likely miss, just behind Earth and to the south, however a further glancing interaction cannot be completely ruled out.

There is also a negative polarity equatorial coronal hole, CH72/CH73, whose fast wind will likely arrive either late day 1 (9th) or more likely day 2 (10th). This is low confidence however, as this is a new feature on this rotation, and any signal from STEREO A has been dominated by the arrival of the CME which glanced Earth. Enlil suggests an arrival later on the 10th, with speeds approaching 500 km/s.

Geomagnetic activity is forecast to be Quiet, isolated Unsettled at first on day 1 (9th), increasing to Active with a chance of G1/Minor Storms from the fast wind arrival, most likely on day 2 (10th). Should any CME glancing interaction also occur, G1/Minor storms are likely, with a slight chance G2/Moderate storms. Geomagnetic activity then easing to Quiet to Unsettled later day 3 and day 4 (11th and 12th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	40	20	1
Strong	G3	No	1	2	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
07/1410	Partial	Filament Eruption	37E19S	468 km/s	N/A	Expected to miss, but low chance glancing influence late on 10th.

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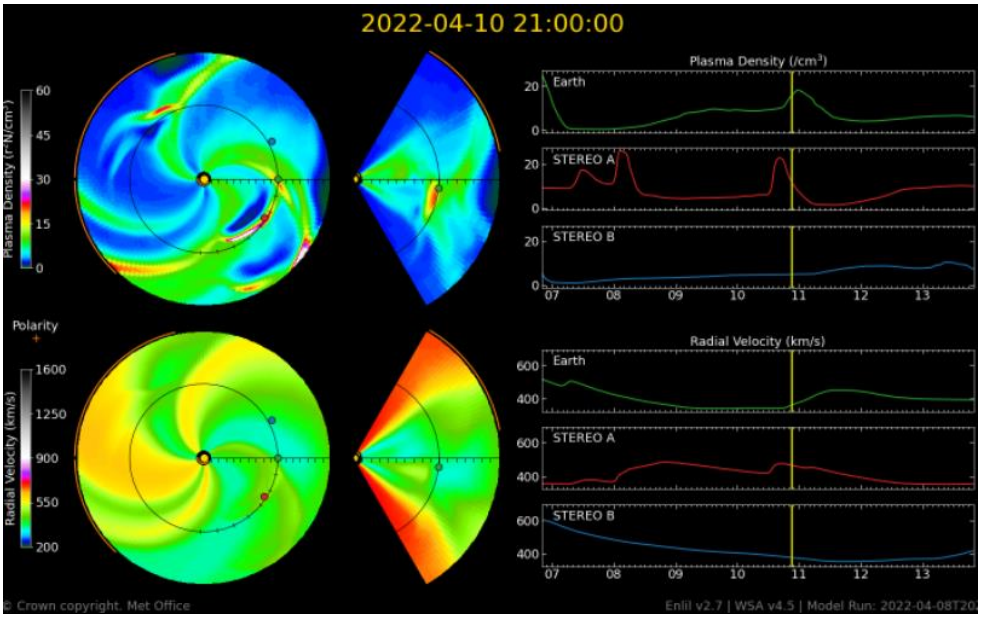
Figure 4: Enlil showing CME missing, however ensemble (below) showing potential for glancing influence. Also shows fast wind arrival at a similar time (late 10th, into 11th).



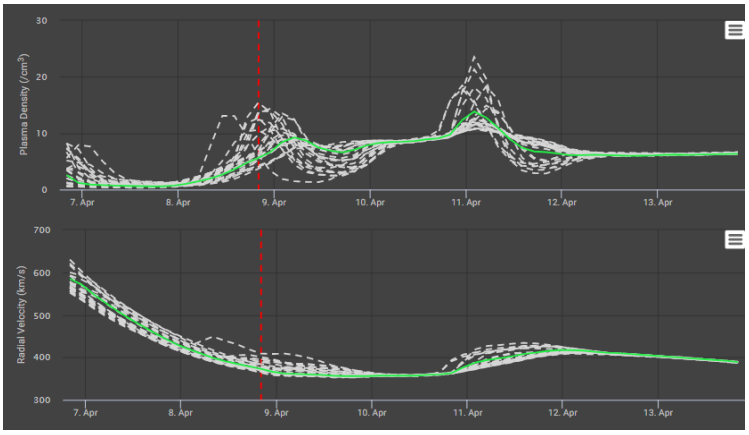
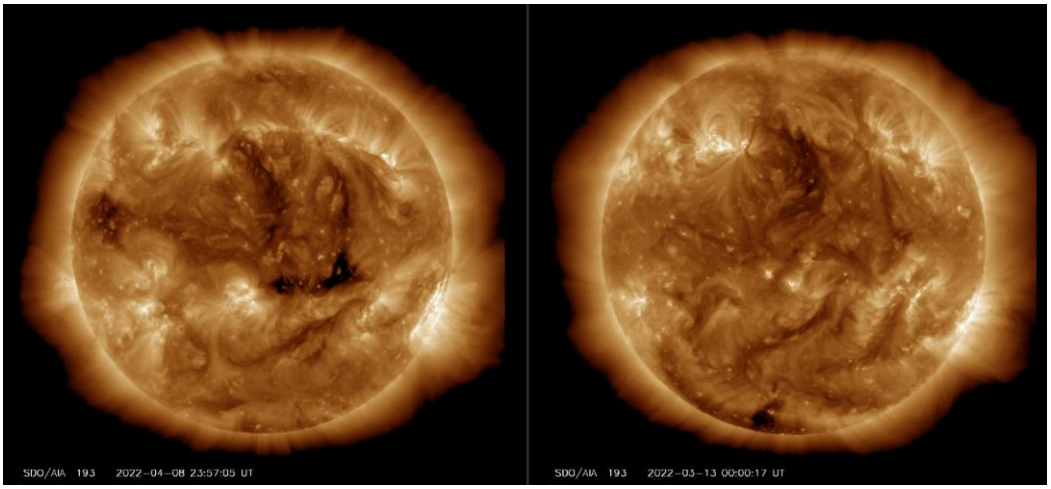


Figure 5: SDO: aia 193 of current rotation (left) and previous (right). CH72/73 newly developed.



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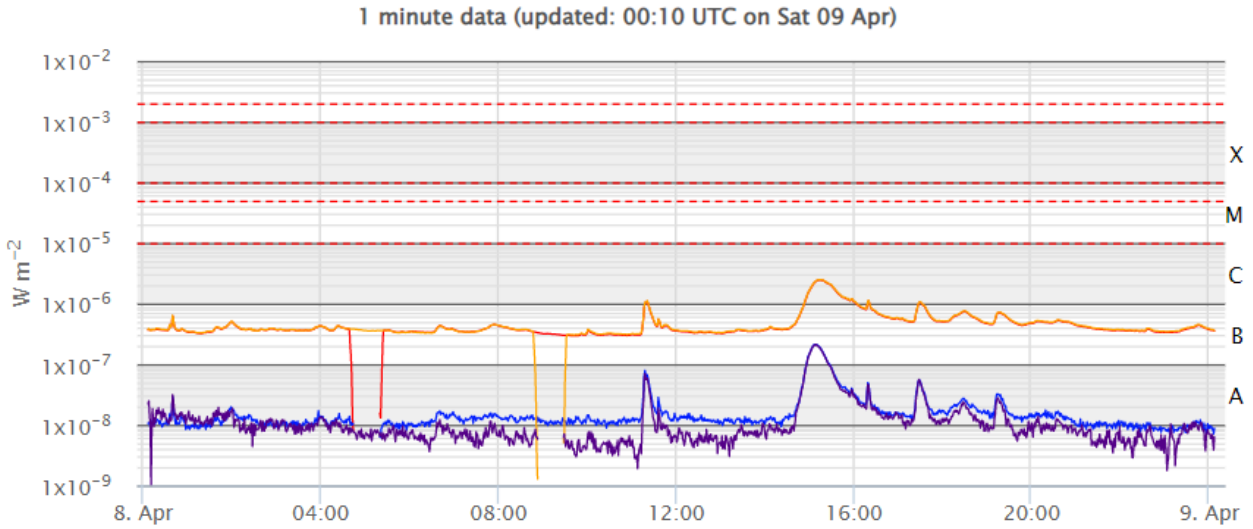
Radio Blackouts - X-Ray Flares:

There are four sunspot regions on the Earth-facing disc, and all are relatively simple and inactive. The largest region, AR2978 Hhx/alpha is now approaching the southwest limb as a mature region set amongst a larger area of plage. Nearby AR2981 Hrx/alpha has become less visible as it too rotates to the southwest limb, whilst the other two regions AR2983 Bxo/Beta in the northwest and AR2985 near the southern centre disc, remain very small and stable regions.

Overall, activity has been Low, with a few small C-flares, and a longer period C1-flare from AR2978. Low to Very Low activity is expected to persist, with only a very slight chance of rising to moderate with any M-flares, and with this risk fading as AR2978 rotates off the Earth-facing disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	2	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 6: GOES 16/17 X-ray Flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background and in the absence of complex sunspots on the Earth-facing disc is expected to remain at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV), as observed by GOES-16 at GEO, has declined to Normal Background levels and is expected to persist at similar levels through much of the period. However, the flux may exceed the High threshold (1000 pfu) at the peak of the diurnal cycle during day 3 and 4 (11th and 12th) as a result of the arrival of any fast wind from CH72 either late day 1 or day 2 (9th or 10th).

The associated 24 hour fluence is below the Active (1e8 integrated pfu) threshold and is likely to remain below through the forecast period, although a rising trend is probable days 3 and 4 (11th), giving a chance of rising above. The Met Office REFM output is currently considered to be giving good guidance in the trend through days 1-2 (9th and 10th), but becomes lower confidence day 3 (11th) due to uncertainties around the arrival of the fast wind

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	10	30	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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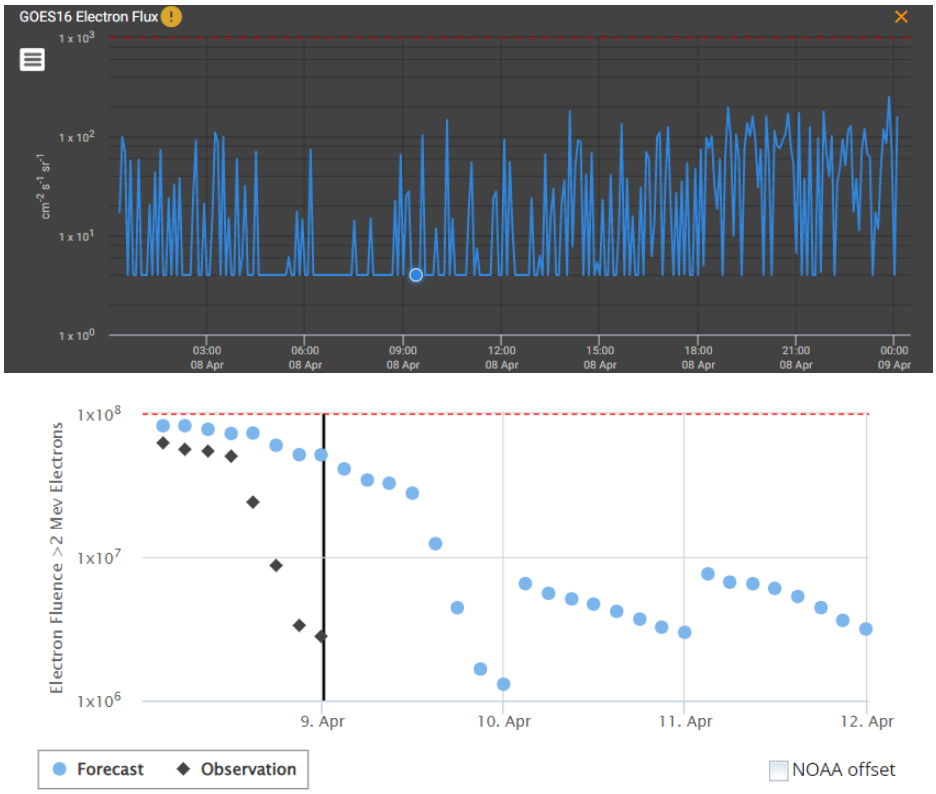
Figure 7: GOES-16 >2 MeV Electron Flux (top) with associated 24 hr Fluence and REFM (bottom)



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